NELP Concludes Evaluation of Scale Prevention Device

Device Is Deemed Ineffective During USS THE SULLIVANS Demonstration

The Navy Environmental Leadership Program (NELP) in cooperation with Commander, Southern Division, Naval Facilities Engineering Command (SOUTHDIV), and Naval Surface Warfare Center, Carderock Division (NSWCCD) has concluded a Scale Prevention Device Evaluation Study. The study was conducted to determine if a scale inhibiting device and epitaxial nucleation technology could eliminate or reduce the build up of scale in Masker and Prairie Air Coolers aboard USS THE SULLIVANS (DDG 68), in the Main Engine Room (MER) 1.

Background

The Bleed Air System (BAS) coolers on surface combatants are unreliable, a maintenance burden, and costly to repair. This lack of reliability significantly undermines the performance of other major components in the BAS. Scale builds up on the tubes in the

NELP reviewed new technologies that would prevent costly scale build up on U.S. Navy ship coolers and at the same time eliminate exposure of Sailors to hazardous materials.

A Scale Prevention Device Evaluation Study was conducted to determine if a scale inhibiting device and epitaxial nucleation technology could eliminate or reduce the build up of scale in Masker and Prairie Air Coolers aboard the guided missile destroyer USS THE SULLIVANS (DDG 68).

U.S. Navy photo by Photographer's Mate 1st Class Jim Hampshire

USS THE SULLIVANS (DDG 68) has completed a NELP sponsored Scale Prevention Device Evaluation Study to determine the effectiveness of an alternative scale inhibiting device to control the buildup of scale in the Masker and Prairie Coolers.

U.S. Navy photo

coolers, resulting in a severe loss of heat transfer capacity due to insufficient cooling of the bleed air. (NOTE: Bleed air is air extracted from the last stage of the compressor on the gas turbine generators (GTG) and gas turbine mains (GTM). Bleed air is used on Masker Air Coolers to mask the main propulsion hull noises and on Prairie Air Coolers to mask propeller noises.) This phenomenon is due to the precipitation of calcareous deposits or scale on the saltwater side of the shell and tube cooler.

A common practice to minimize the effects of the calcareous deposits or scale in the coolers is to perform an acid flushing either in-situ or after removal to a shore facility. The acid flushing creates a hazardous waste due to high concentrations of metal ions in the effluent and also because the waste generated has a pH lower than the minimum limit as specified under the Resource Conservation and Recovery Act (RCRA). Sailors are often in direct contact with hazardous chemicals during and after the flushing procedure.

In light of these problems, NELP reviewed new technologies that would prevent costly scale build up on U.S. Navy ship coolers and at the same time eliminate exposure of Sailors to hazardous materials used during maintenance procedures. A scale-inhibiting device (FreFlo™) was selected for evaluation, based on initial testing on the Number 1 Evaporator on the USS ANCHORAGE (LSD 36), the FreFlo™ device showed promise as a mechanism that would prevent scale formation. According to the manufacturer, FreFlo™ uses epitaxial nucle-

The Basics About Epitaxial Nucleation Technology

Epitaxial nucleation technology refers to the growth of scale calcium carbonate (scale) crystals in the Scale Prevention Device core. This growth is caused when water enters the Scale Prevention Device housing and undergoes a pressure drop and turbulent flow. This causes dissolved carbon dioxide (CO_2) to become a gas in the water. This changes the chemical characteristics of the water to a "saturated" condition that promotes the growth of scale crystals. The scale crystals then act as an alternative growth surface for the scale in the saturated water to adhere to. The crystals are then suspended in the water to be carried out of the core housing and discharged when the water exits the system. This process is supposed to keep equipment clean and send scale down the drain.

ABOUT NELP

The Chief of Naval Operations chartered NELP at NAVSTA Mayport in 1993. The mission of NELP is to support Navy warfighter operational readiness through the identification, demonstration and communication of innovative ways to perform daily operations while minimizing the impacts on our environment and promoting environmental stewardship. The program serves as a test bed for new and innovative technology and focused management that addresses the full spectrum of environmental issues. NELP exports its successes and lessons learned throughout the Navy and Marine Corps family.

ation and lattice matching, a process similar to ion exchange, to prevent scale build-up. The scale that would normally build up on pipes is grown within the FreFlo™ device and then carried away in suspension.

For this evaluation study, one FreFlo™ device was installed upstream and inline with the Masker and Prairie Cooler seawater supply in MER 1 before the USS THE SULLIVANS (DDG 68) departed on a six-month deployment. (Both coolers have a common seawater supply pipe and also take in bleed air from the same source.) The coolers in MER 2 did not have the FreFlo™ device installed and served as the controls for a quantitative and qualitative comparison. An analysis was performed to determine the heat transfer and seawater flow rates of all four coolers. The Masker and Prairie Air Coolers were cleaned and inspected prior to installing the FreFlo™ device and inspected again upon the ship's return from deployment.

> The FreFlo™ device did not prevent or inhibit the build-up of scale during the evaluation period.

Lessons Learned

Based on the results of the scale prevention device evaluation study, the FreFlo™ device did not prevent or inhibit the build-up of scale during the evaluation period. The systems that had the device installed showed an increase in scale build up greater than that noted in the systems without the FreFlo™ device. It has therefore been determined that the FreFlo™ device did not meet the claims or technological objectives stated by the manufacturer. Both qualitative and quantitative data were used to support this conclusion.

Lessons learned and final recommendations were to remove the FreFlo™ device from DDG 68, return the ship to normal configuration, and close out the "Departure from Specifications." Secondly, no further evaluation or installation of this device or technology should be pursued aboard U.S. Navy Ships.

"We all benefit from lessons learned from testing new technologies like the FreFlo™ device. We learn what works and what does not work," said CDR Mark Solberg, NELP Focus Group Member. "We provide this information as part of our continued commitment to address a wide spectrum of technology and environmental issues." ⚓

CONTACTS

Diane Lancaster
Naval Station Mayport
904-270-6730, x-208
DSN: 960-6730, x-208
DLancaster@nsmayport.spear.navy.mil

LCDR Joseph Campisano
Naval Station Mayport
904-270-6730, x-203
DSN: 960-6730, x-203
JCampisano@nsmayport.spear.navy.mil